

**ble 3.** If it is out of specification, replace the inner and outer rotors.

9. Using a flat feeler gauge and straightedge, measure the clearance between the body surface and rotors (**Figure 99**) and check it against the side clearance in **Table 3**. If it is out of specification, replace the oil pump assembly.

### Reassembly

1. If necessary, reclean the parts as described in the previous section. Lubricate the rotors, base, body and spacer with engine oil when installing them in the following steps.
2. Install the outer and inner rotors (C, **Figure 95**) into the pump body. When installing the original rotors, install them with their original side facing up as identified during disassembly.
3. Install the pump shaft (A, **Figure 95**) and drive pin into the inner rotor. The flat end of the shaft must be out.
4. Install the dowel pins (B, **Figure 95**) into the pump body.
5. Install the spacer onto the pump body.
6. Install the thrust washer (B, **Figure 94**) and drive pin (A).
7. Install the inner and outer rotors into the pump base (**Figure 93**). When installing the original rotors, install them with their original side facing up as identified during disassembly.
8. Mate the pump base with the body/spacer assembly. Make sure the pump shaft drive pin aligns with the slot in the inner rotor.

#### NOTE

*Be sure there are no gaps between the mating surfaces of the pump base, spacer and body. If a gap exists, disassemble the pump and find the cause.*

9. Install and tighten the bolt (A, **Figure 92**).
10. Turn the pump shaft. If there is any roughness or binding, disassemble the oil pump and check it for damage.
11. Lubricate the relief valve and spring with engine oil. Install the relief valve (C, **Figure 91**) so the stepped end is toward the spring. Install the spring (B, **Figure 91**) and spring seat (A). Push in the spring seat and install the cotter pin (**Figure 90**). Bend the cotter pin ends around the pump.



12. Store the oil pump in a plastic bag until installation.

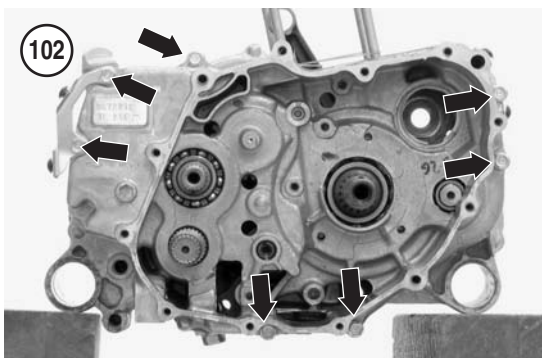
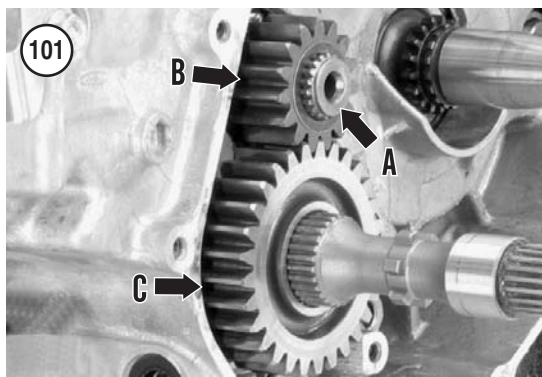
### OIL STRAINER SCREENS

Two oil strainer screens are installed inside the crankcase. Service the oil strainer screens whenever splitting the crankcase. Refer to *Crankcase and Crankshaft* in this chapter.

### CRANKCASE AND CRANKSHAFT

The crankcase is made in two halves of thin-wall, precision diecast aluminum alloy. To avoid damage, do not hammer or pry on any of the interior or exterior projected walls. A liquid gasket seals the crankcase halves while dowel pins align the crankcase halves when they are bolted together. The crankcase halves can be replaced separately.

The crankshaft assembly consists of two full-circle flywheels pressed together on a crankpin. Two ball bearings in the crankcase support the crankshaft assembly.



The following procedure is a complete, step-by-step major lower end overhaul. When servicing only the transmission, the crankcase may be disassembled and reassembled without removing the crankshaft.

References to the front and rear side of the engine, as used in the text, refer to the engine as it sits in the frame, not as it sits on a workbench.

### Special Tools

A press is required to remove the crankshaft from the crankcase.

To install the crankshaft into the crankcase, a number of Honda crankshaft installation tools or their equivalents will be required. These tools and part numbers are called out during the crankshaft installation procedure in this chapter.

### Crankcase Disassembly

This procedure describes disassembly of the crankcase halves and removal of the transmission and internal shift mechanism. Crankshaft removal is covered in a separate procedure.

Chapter Seven describes transmission and internal shift mechanism service procedures.

1. Remove all exterior engine assemblies as described in this chapter and other related chapters:
  - a. Cylinder head (Chapter Four).
  - b. Cylinder and piston (Chapter Four).
  - c. Recoil starter (this chapter).
  - d. Flywheel and starter clutch (this chapter).
  - e. Starter motor (Chapter Nine).
  - f. Clutch and primary drive gears (Chapter Six).
  - g. Gearshift linkage (this chapter).
  - h. Oil pump (this chapter).
2. Remove the engine dampers and bushings (**Figure 100**).
3. Remove the washer (A, **Figure 101**), drive gear (B) and driven gear (C) if they were not previously removed.

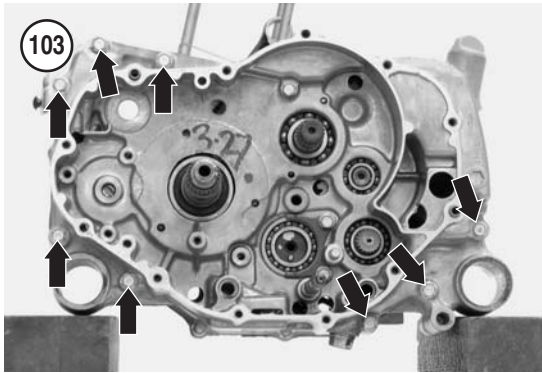
#### NOTE

*To prevent loss and to ensure proper bolt location during assembly, draw the crankcase outline on cardboard, then punch holes to correspond with bolt locations. Insert the bolts in their appropriate locations after removing them.*

4. Loosen and remove the rear crankcase bolts (**Figure 102**) in a crossing pattern. Install them in the cardboard.
5. Turn around the engine so the front side (clutch side) is accessible.
6. Loosen and remove the front crankcase mounting bolts (**Figure 103**) in a crossing pattern. Install them in the cardboard.

#### CAUTION

*Perform this operation over and close to the work bench as the crankcase*



*halves may easily separate. Do not hammer on the crankcase halves.*

#### CAUTION

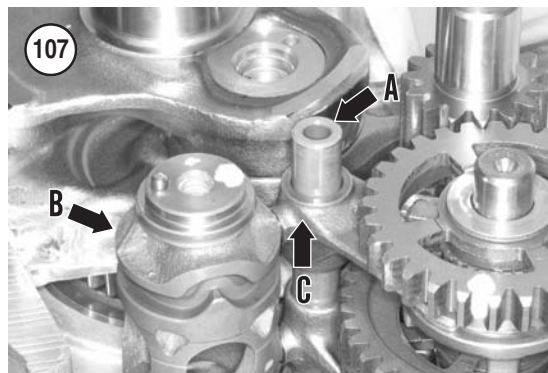
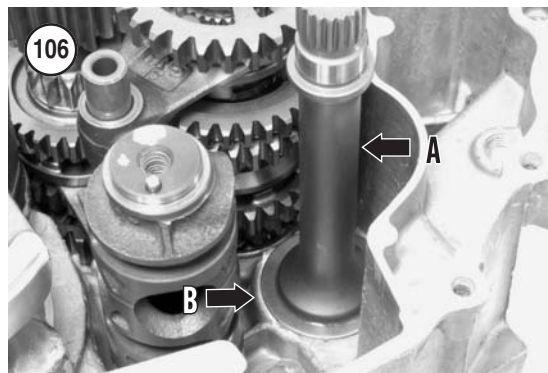
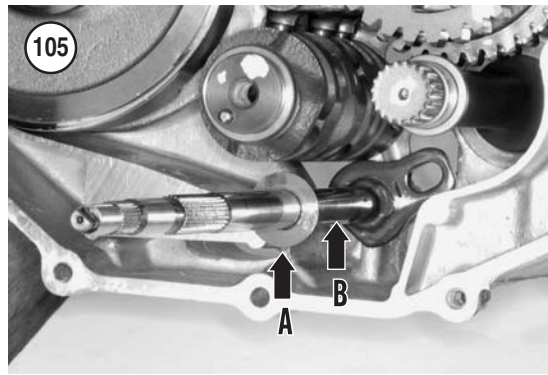
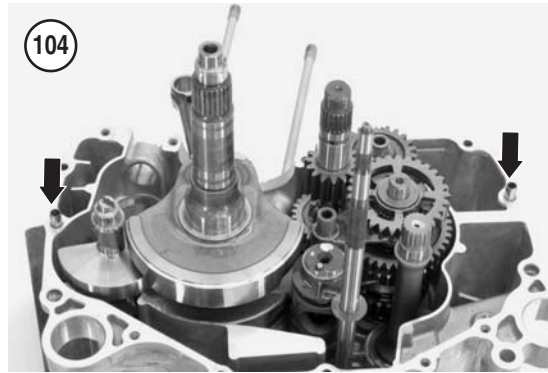
*Do not pry between the crankcase mating surfaces when separating the crankcase halves. Doing so may cause an oil leak.*

7. Position the crankcase on wooden blocks so the crankshaft is vertical and the front side is up.
8. Tap on the front crankcase half using a soft-faced hammer while lifting it off the engine. Tap the transmission shafts if they bind with the crankcase and prevent disassembly.
9. If necessary, remove the dowel pins (**Figure 104**).

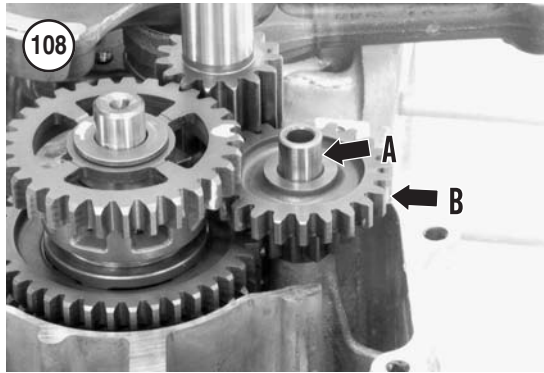
#### NOTE

*Steps 10-14 describe removal of the transmission assembly.*

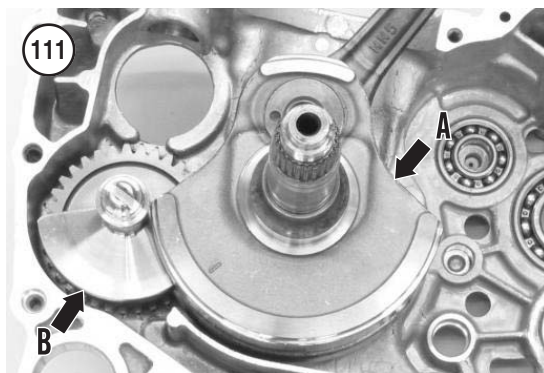
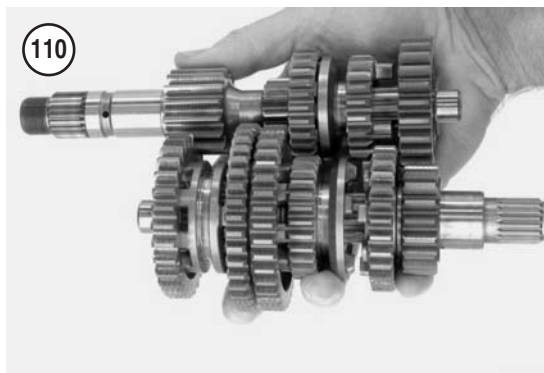
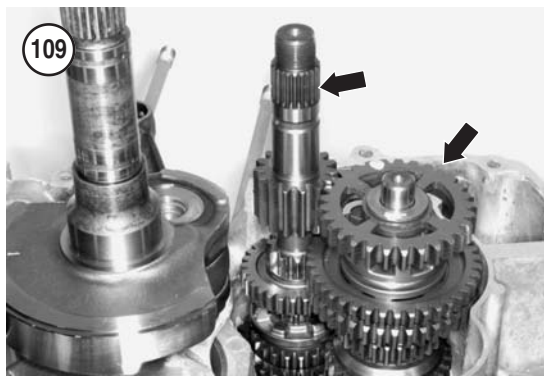
10. Remove the washer (A, **Figure 105**) and sub-gearshift spindle (B).
11. Remove the output shaft (A, **Figure 106**) and washer (B).
12. Remove the shift fork assembly as follows:
  - a. Remove the shift fork shaft (A, **Figure 107**) and shift drum (B).
  - b. Remove the three shift forks (C, **Figure 107**).
13. Remove the shaft (A, **Figure 108**) and the reverse idler gear assembly (B).
14. Remove the mainshaft and countershaft assemblies (**Figure 109**) at the same time. See **Figure 110**.
15. If necessary, remove the crankshaft and balancer shaft as described in the following section.







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### Crankshaft/Balancer Shaft Removal

Remove the crankshaft (A, **Figure 111**) and balancer shaft (B) as follows:

1. Support the rear crankcase in a press.

#### CAUTION

*When the rear crankcase is being supported in the press, make sure there is adequate room to press the crankshaft out without the connecting rod hitting against the press bed. If this happens, a connecting rod may be bent. Check the setup carefully before applying pressure to the crankshaft.*

#### CAUTION

*Catch the crankshaft and balancer shaft once the crankshaft is free of the rear crankcase half. Otherwise, these parts can fall to the floor, causing severe damage.*

2. Center the crankshaft under the press ram (**Figure 112**) and press the crankshaft out of the crankcase.
3. Remove the crankshaft and balancer shaft from the crankcase half.
4. Remove the rear crankcase from the press.

### Crankcase Inspection

1. Remove all gasket residue from the crankcase mating surfaces.

#### CAUTION

*When drying the crankcase bearings in Step 3, do not allow the inner bearing races to spin. The bearings are not lubricated and damage may result.*

*When drying the bearings with compressed air, do not allow the air jet to spin the bearing. The air jet can rotate the bearings at excessive speeds. This could cause a bearing to fly apart, causing personal injury.*

2. Clean both crankcase halves and all crankcase bearings with solvent. Thoroughly dry them with compressed air.
3. Flush all crankcase oil passages with compressed air.
4. Lightly oil all of the crankcase bearings with engine oil before checking the bearings in Step 5.
5. Check the bearings for roughness, pitting, galling and play by rotating them slowly by hand. Replace any bearing that turns roughly or has excessive play (**Figure 113**).
6. Replace any worn or damaged bearings as described in *Crankcase Bearing Replacement* in this section.

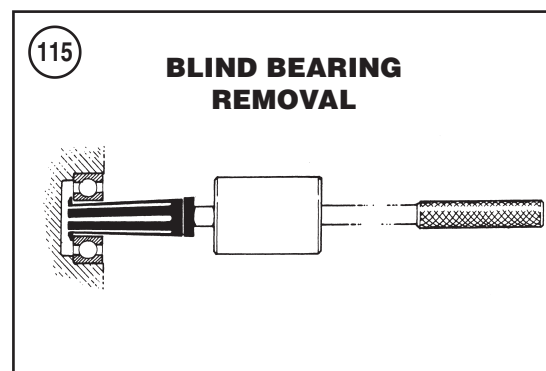
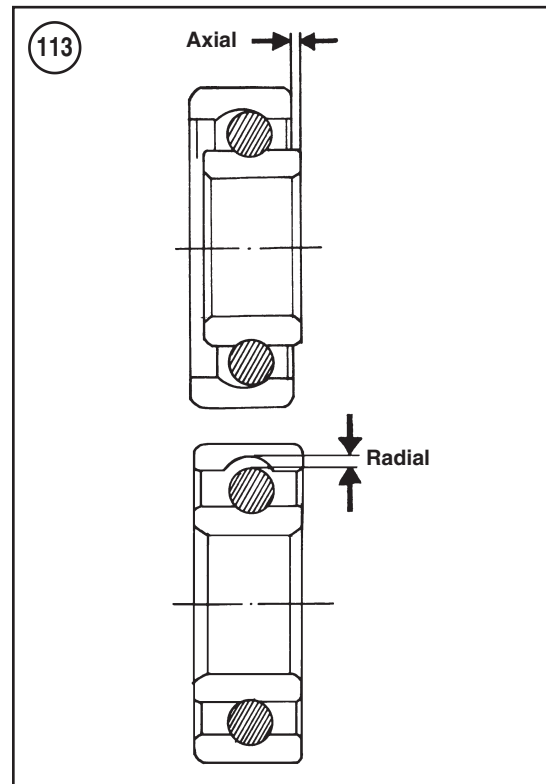
#### NOTE

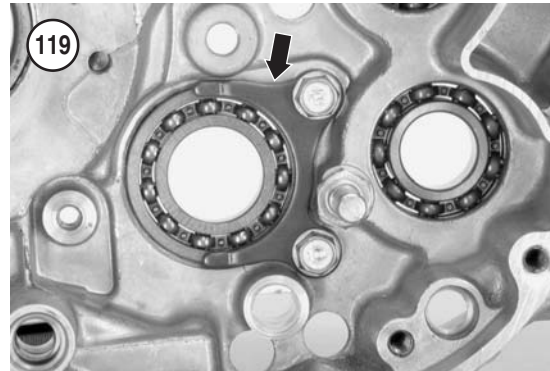
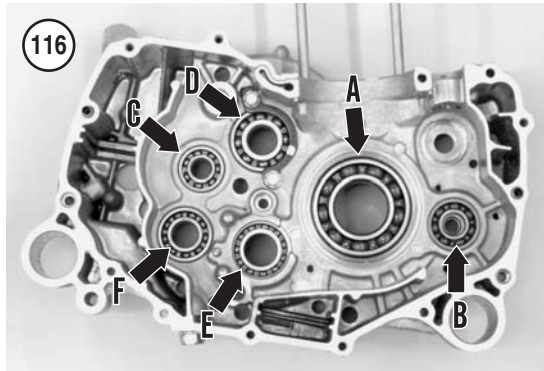
*Always replace the opposing bearing at the same time.*

7. Carefully inspect the cases for cracks and fractures, especially in the lower areas where they are vulnerable to rock damage.
8. Check the areas around the stiffening ribs, around bearing bosses and threaded holes for damage. Refer crankcase repair to a shop specializing in the repair of precision aluminum castings.
9. Check the threaded holes in both crankcase halves for thread damage, dirt or oil buildup. If necessary, clean or repair the threads with the correct size metric tap. Coat the tap threads with kerosene or an aluminum tap fluid before use.
10. Check the gearshift stopper pin (**Figure 114**) for looseness or damage. During installation, apply a threadlock to the bolt threads and tighten them to 22 N•m (16 ft.-lb.).

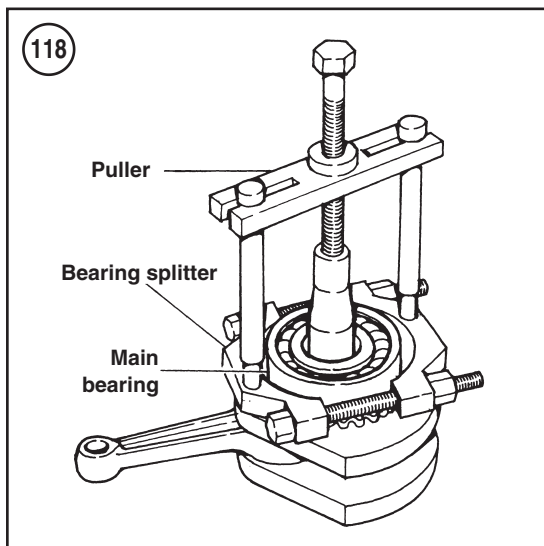
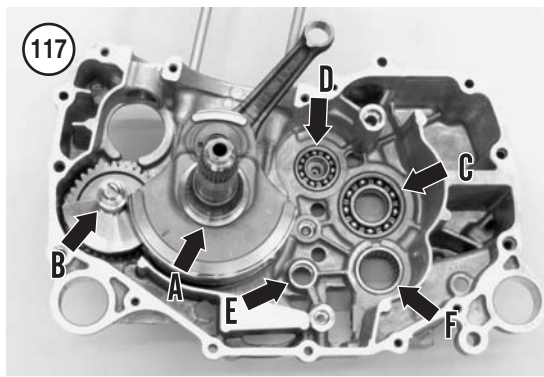
### Crankcase Stud Replacement

The crankcase studs are different lengths. When replacing the studs, measure their length prior to removal.





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### Crankcase Bearing Replacement

When replacing bearings in the following steps, note the following:

1. Because of the number of bearings used in the front and rear crankcase halves, identify the bear-

ings before removing them. Identify each bearing by referring to its size code marks.

2. Before removing the bearings, note and record the direction in which the bearings size codes face for proper reinstallation.

3. Replace the bearings as described in *Bearing Replacement* in Chapter One. Use a blind bearing remover to remove bearings installed in blind holes (**Figure 115**).

4. Refer to **Figure 116** to identify the bearings installed in the front crankcase half.

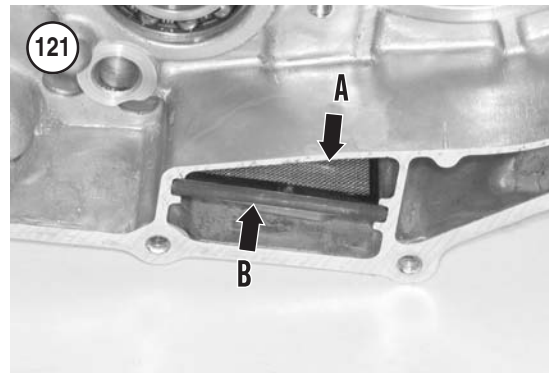
- a. Crankshaft (A).
- b. Balancer shaft (B).
- c. Countershaft (C).
- d. Mainshaft (D).
- e. Shift drum (E).
- f. Final driveshaft (F).

5. Refer to **Figure 117** to identify the bearings installed in the rear crankcase half.

- a. Crankshaft (A).
- b. Balancer shaft (B).
- c. Countershaft (C).
- d. Mainshaft (D).
- e. Shift drum (E).
- f. Final driveshaft (F).

6. If the rear crankshaft bearing remained on the crankshaft, remove the bearing with a bearing splitter and bearing puller as shown in **Figure 118**. Press a new bearing into the rear crankcase half. Do not install the bearing onto the crankshaft.

7. On a bearing so equipped, remove the bolts (**Figure 119**, typical) securing the bearing retainer plate and remove the retainer plate. If bearing replacement is not required, check the retaining screws for tightness.

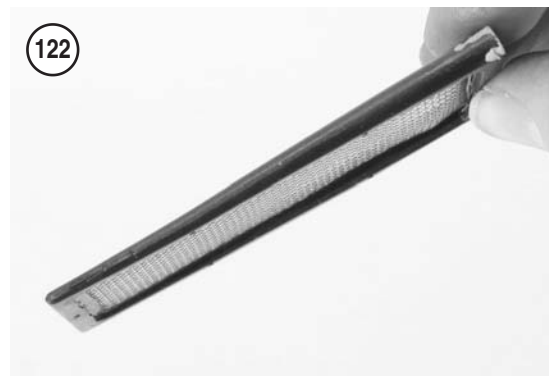


### Oil Strainer Screens

Two oil strainer screens are installed inside the crankcase. Both screens are located in the front crankcase half (**Figure 120** and A, **Figure 121**). A strainer plate is located below the bottom strainer (B, **Figure 121**).

When the engine is disassembled, remove and clean the strainer screens and the strainer plate using solvent.

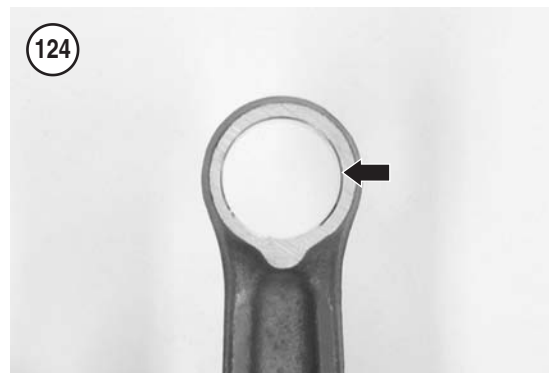
The strainer screens are tapered (**Figure 122**). Install the screen by inserting the thin edge first. Install the strainer plate so the hole is toward the crankcase mating surface (**Figure 123**).



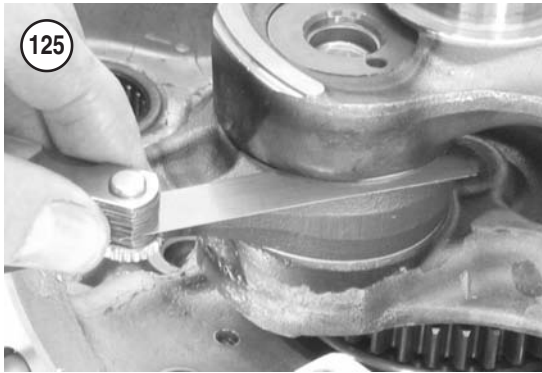
### Crankshaft Inspection

Handle the crankshaft carefully while performing the following cleaning and inspection procedures. Individual crankshaft components are not available separately. If the crankshaft is excessively worn or damaged, or if any measurement is out of specification, replace the crankshaft as an assembly.

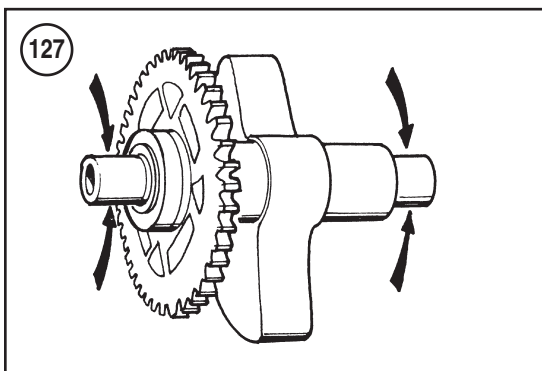
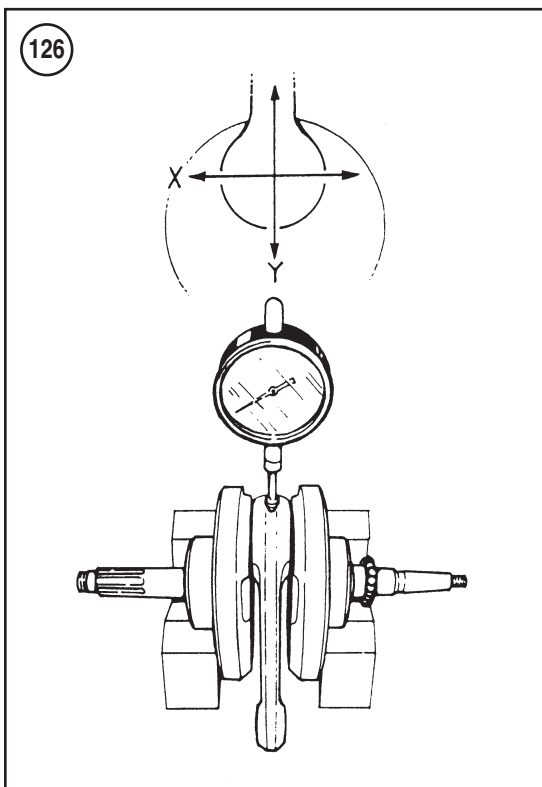
1. Clean the crankshaft thoroughly with solvent. Clean the crankshaft oil passageway with compressed air. Dry the crankshaft with compressed air, then lubricate all bearing surfaces with a light coat of engine oil.
2. Check the crankshaft journals for scratches, heat discoloration or other defects.
3. Check the flywheel taper, threads and keyway for damage.
4. Check the connecting rod big end for signs of damage, including bearing or thrust washer damage.
5. Check the connecting rod small end for signs of excessive heat (blue coloration) or other damage.







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6. Measure the connecting rod small end inside diameter (**Figure 124**) with a snap gauge or an inside micrometer and check the measurement against the dimension in **Table 4**.

7. Slide the connecting rod to one side and check the connecting rod side clearance with a flat feeler gauge (**Figure 125**) and check it against the dimension in **Table 4**.

8. Place the crankshaft on a set of V-blocks or between lathe centers and measure runout with a dial indicator at the points listed in **Table 4**. If the runout exceeds the service limit in **Table 4**, take the crankshaft to a Honda dealership for service or replacement.

9. Place the crankshaft on a set of V-blocks and measure the connecting rod big end radial clearance with a dial indicator. Measure it in the two directions shown in **Figure 126** and compare the measurements to the dimension in **Table 4**.

### Balancer Shaft Inspection

1. Inspect the balancer shaft bearing journals (**Figure 127**) for deep scoring, excessive wear, heat discoloration or cracks.
2. Examine the oil pump drive slot in the end of the balancer shaft for cracks or excessive wear.
3. Replace the balancer shaft if necessary.

### Final Drive Shaft and Gear Inspection

1. Inspect the final drive shaft (**Figure 128**) for:
  - a. Worn or damaged splines.
  - b. Worn or damaged bearing surfaces.
  - c. Bent shaft.
2. Inspect the final drive shaft gear (**Figure 128**) for:



- a. Missing, broken or chipped teeth.
  - b. Cracked or scored gear bore.
3. Replace the final drive shaft and gear if necessary.

### Transmission Inspection

Refer to Chapter Seven for all disassembly, inspection and reassembly procedures.

### Crankshaft and Balancer Shaft Installation

Use the following Honda tools (or equivalents) to install the crankshaft and balancer shaft into the rear crankcase.

1. Threaded adapter (part No. 07931-KF00200): A, **Figure 129**.
2. Shaft puller (part No. 07931-ME4010B USA only or 07965-VM00200): B, **Figure 129**.
3. Threaded adapter (part No. 07931-HB3020A): C, **Figure 129**.
4. Assembly collar (part No. 07965-VM00100): D, **Figure 129**.

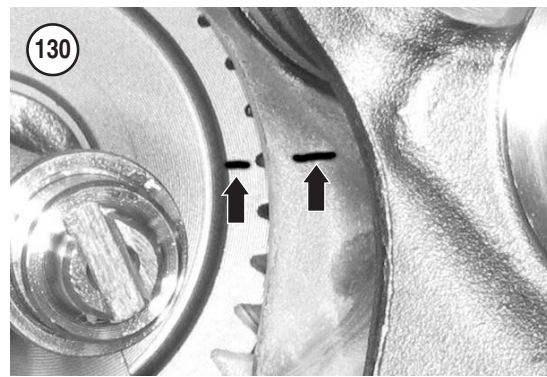
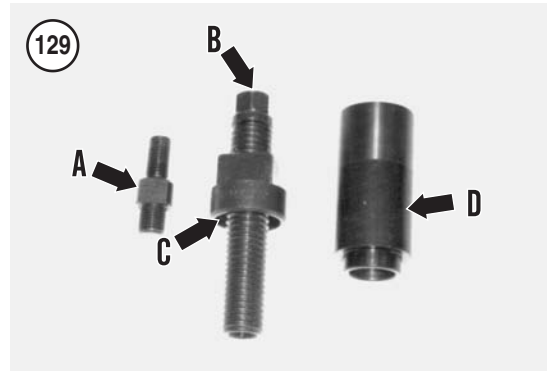
#### NOTE

*Before ordering these tools, confirm the tool part numbers with a Honda dealership.*

1. Place the rear crankcase on wooden blocks with its inside surface facing up.
2. Lubricate the crankshaft and balancer shaft bearings with oil.
3. Align the timing marks on the crankshaft and balancer shaft (**Figure 130**) and install both parts into the rear crankcase. Recheck the timing mark alignment.
4. Install the threaded adapter into the end of the crankshaft (**Figure 131**, typical).
5. Install the crankshaft puller assembly (**Figure 132**) over the end of the crankshaft and thread it into the threaded adapter. Center the tool assembly on the main bearing inner race.

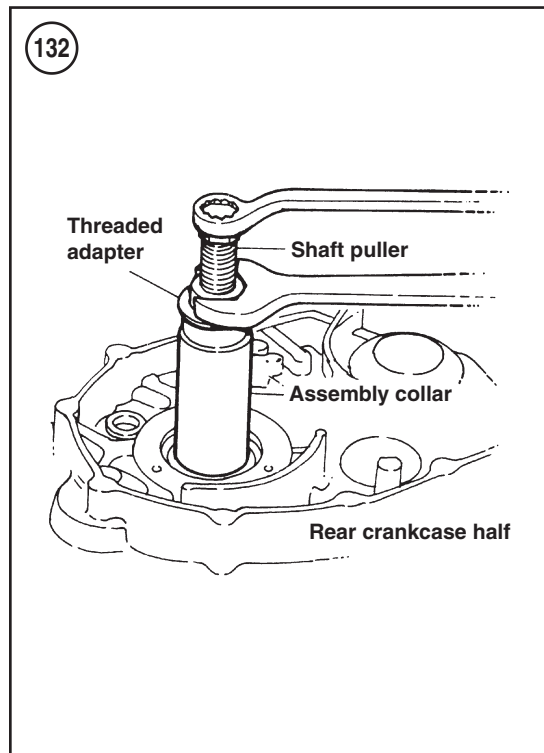
#### CAUTION

*When installing the crankshaft in Step 6, position the connecting rod at its TDC or BDC position. Otherwise, the connecting rod may contact the side of the crankcase, causing expensive*



*connecting rod and crankcase damage.*

6. Hold the threaded adapter and turn the shaft puller to pull the crankshaft into the main bearing. When installing the crankshaft, frequently make sure it is going straight into the bearing and not binding to one side.
7. Continue to turn the shaft puller until the crankshaft bottoms against the main bearing. Remove the crankshaft tools and turn the crankshaft.



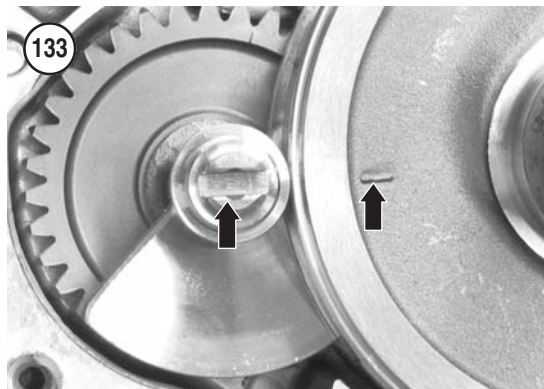
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The crankshaft must turn with no binding or roughness.

8. Make sure the index marks on the crankshaft and balancer shaft align as shown in **Figure 130**. The drive slot in the end of the balancer shaft should align with the mark on the crankshaft counterweight (**Figure 133**).

#### CAUTION

*Severe engine damage will occur if the crankshaft and balancer shaft index marks do not align.*



### Crankcase Assembly

1. Install the crankshaft and balancer shaft into the rear crankcase as described in this chapter.
2. Lightly oil all of the crankcase bearings.
3. Check the assembly of the following components as described in Chapter Seven. Make sure all washers and snap rings are properly installed in their correct position. Set each assembly aside until reassembly:

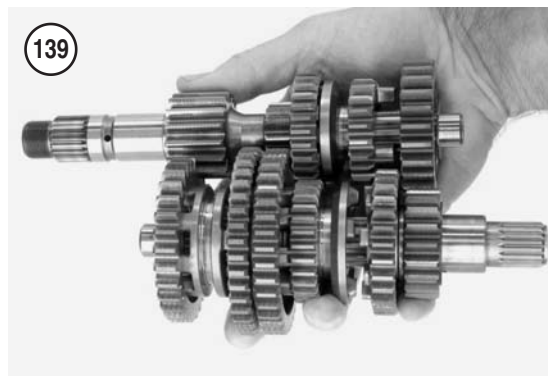
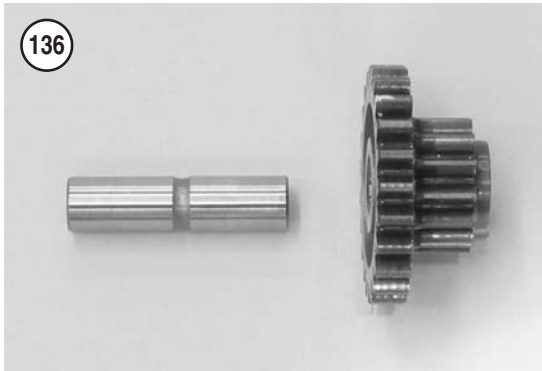
- a. Mainshaft (**Figure 134**).
- b. Countershaft (**Figure 135**).

#### NOTE

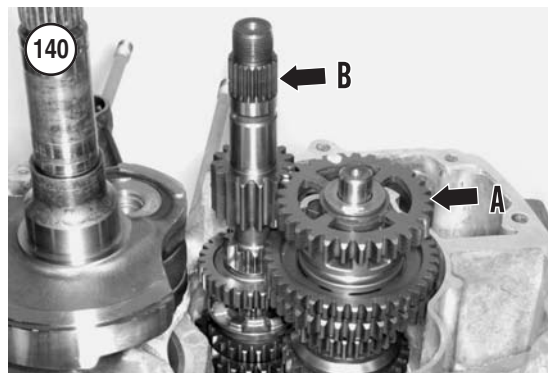
*Do not install the countershaft first gear bushing, first gear and copper washer at this time. They will be installed during the following steps.*



- c. Reverse idler gear assembly (**Figure 136**).
4. Place the rear crankcase half on two wooden blocks.
5. Make sure both crankcase mating surfaces are clean and dry.
6. Install the mainshaft and countershaft as follows:



- a. Make sure the washer (**Figure 137**) is installed on the mainshaft.
- b. Make sure the washer (**Figure 138**) is installed on the countershaft.
- c. Mesh the countershaft and mainshaft together as shown in **Figure 139**.
- d. Install the countershaft (A, **Figure 140**) and mainshaft (B) into the rear crankcase half. Make sure the outer washers did not fall off the mainshaft and countershaft.



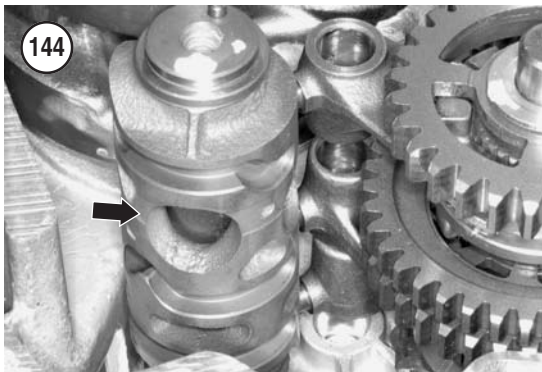
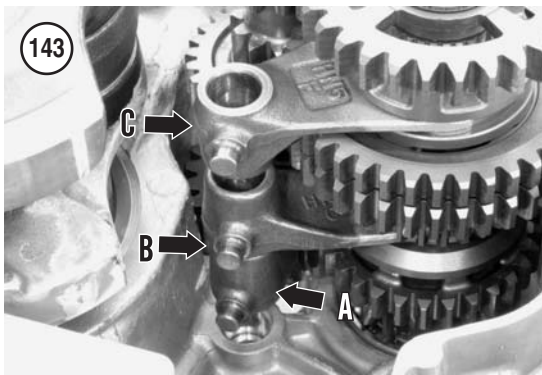
#### NOTE

To identify the shift forks when installing them in Step 7, refer to the letter mark(s) on each shift fork: F (front), C (center) and RR (rear). See **Figure 141**.

7. Install the shift forks (**Figure 142**) and shift drum assembly as follows:

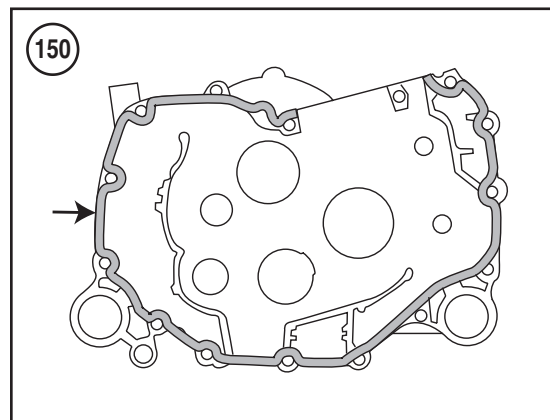
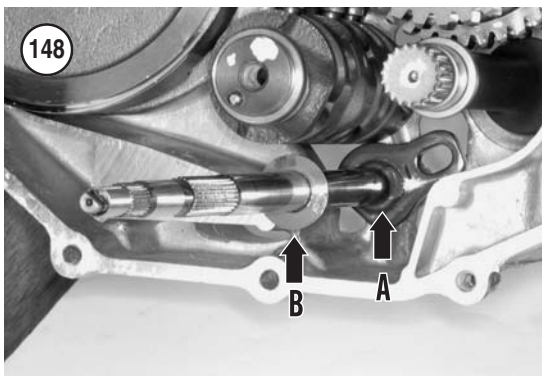
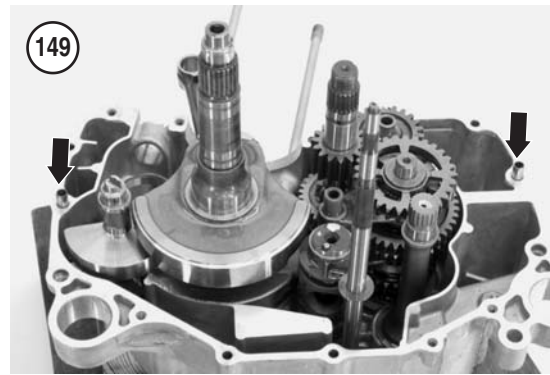
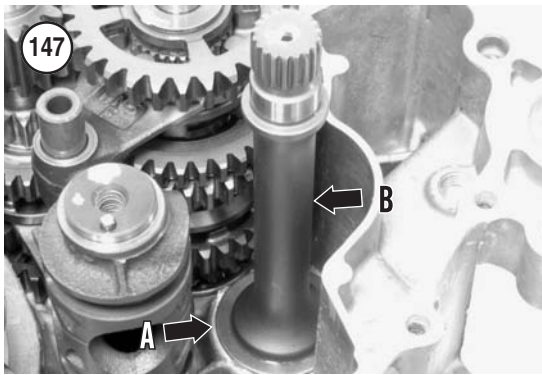
- a. Install each shift fork with the letter mark facing up.
- b. Install the RR (rear) shift fork into the mainshaft third gear groove (A, **Figure 143**).





- c. Install the C (center) shift fork into the countershaft fourth gear groove (B, **Figure 143**).
  - d. Install the F (front) shift fork into the reverse counter shifter groove (C, **Figure 143**).
  - e. Install the shift drum (**Figure 144**) into the crankcase.
  - f. Engage the RR shift fork pin into the bottom shift drum groove.
  - g. Engage the C shift fork pin into the middle shift drum groove.
  - h. Engage the F shift fork pin into the upper shift drum groove.
8. Install the shift fork shaft (**Figure 145**) through the three shift forks. Make sure each shift fork is still engaged with its respective gear and its pin is in the correct shift drum groove.
  9. Install the reverse idler gear and shaft (**Figure 146**).
  10. Spin the transmission shafts and shift through the gears using the shift drum. Make sure it shifts into each gear correctly.
  11. After making sure the transmission shifts into all of the gears correctly, shift the transmission assembly into neutral.
  12. Install the washer (A, **Figure 147**) and output shaft (B).
  13. Install the sub-gearshift spindle (A, **Figure 148**) and washer (B).
  14. Make sure the oil screens are installed as described in *Oil Strainer Screens*.
  15. Install the two dowel pins (**Figure 149**) if they were removed.
  16. Lubricate all of the shafts and gears with engine oil.
  17. Thoroughly clean the mating surfaces of the crankcases halves. Apply a bead of Yamabond No.





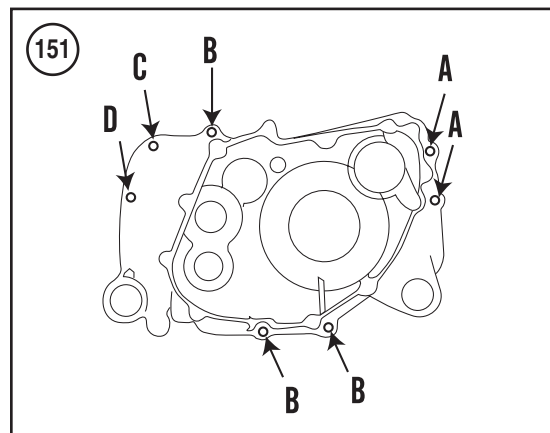
4 or equivalent to the front crankcase half mating surface as shown in **Figure 150**.

18. Align the front crankcase half with the shafts and crankshaft, and install it onto the rear crankcase half. Push the crankcase down squarely into place until it engages the dowel pins and then seats completely against the rear crankcase half.

#### CAUTION

*When the shafts align properly, the front crankcase can be installed without the use of force. If the crankcase halves do not fit together completely, do not pull them together with the crankcase bolts. Remove the front crankcase half and investigate the cause of the interference. If the transmission or reverse assemblies were disassembled, make sure a gear was not installed incorrectly. If the crankshaft was removed, make sure it is installed and seated properly in the rear crankcase main bearing.*

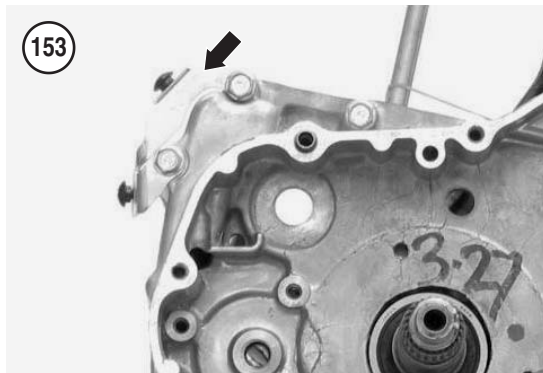
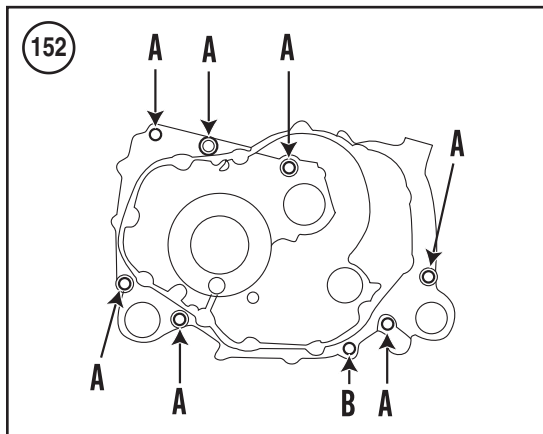
19. Turn all of the exposed shafts, crankshaft and shift drum. Each component must turn freely with



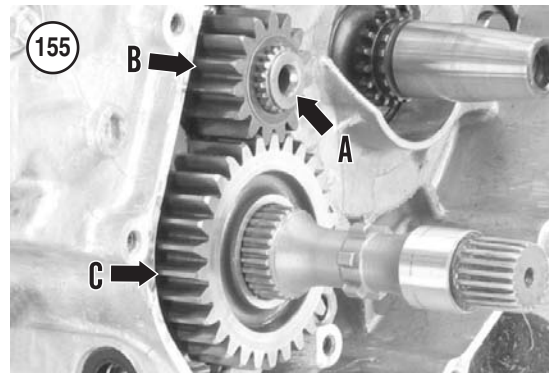
no binding. If everything turns properly, continue with Step 20.

20. Refer to the cardboard guides made during disassembly, or use **Figure 151** and **Figure 152** as follows:

- a. A = M6 × 75.
- b. B = M6 × 40.
- c. C = M6 × 105.
- d. D = M6 × 115.



21. Install the front crankcase mounting bolts. Be sure to install the engine cover bracket (**Figure 153**). Tighten the crankcase mounting bolts in a crossing pattern to 12 N•m (106 in.-lb.).
22. Install the rear crankcase mounting bolts. Be sure to install the engine cover bracket (**Figure 154**). Tighten the crankcase mounting bolts in a crossing pattern to 12 N•m (106 in.-lb.).
23. Rotate the transmission shafts and crankshaft to ensure there is no binding. If there is any binding,



disassemble the engine as needed and correct the problem.

24. Perform *Transmission Shifting Check* in this chapter.
25. Install the drive gear (B, **Figure 155**) and driven gear (C). Install the drive gear so the splined end is out. Install the washer (A, **Figure 155**) next to the drive gear.
26. Inspect the engine mounting dust seal and bushing (**Figure 156**) sets for severe wear or damage.
27. Install the bushing sets so the outer dust seal lips face out as shown in **Figure 157**.
28. Install all exterior engine assemblies as described in this chapter and other related chapters.

### TRANSMISSION SHIFTING CHECK

Transmission shifting can be checked with the engine mounted in the frame or with it sitting on the workbench. Always check transmission shifting after reassembling the engine cases.

1. Rotate the shift drum using the end slot (A, **Figure 158**) so the transmission is in neutral. Neutral

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